AD-A051 493 TEXAS UNIV AT AUSTIN CENTER FOR NUMERICAL ANALYSIS F/G 12/1
COMPUTATIONAL AND APPLIED MATHEMATICS.(U)
JAN 78 D M YOUNG DAHC04-74-G-0198

UNCLASSIFIED ARO-12301.5-M NL

1 OF 1
AD
A051493

END
DATE
FILMED
4-78
DDC

Unclassified
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

(18) ARO (19) 12301.5-M

AD A051493

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: ~~FINAL REPORT~~ 12301.5-M
2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER: 9
4. TITLE (and Subtitle): (6) COMPUTATIONAL AND APPLIED MATHEMATICS
5. TYPE OF REPORT & PERIOD COVERED: Final Report. ~~10-1-74 through 11-30-77~~
6. PERFORMING ORG. REPORT NUMBER: 1 Oct 74 - 30 Nov 77
7. AUTHOR(s): (10) David M. Young, Jr., Principal Investigator
8. CONTRACT OR GRANT NUMBER(s): (15) DAHC04-74-G-0198
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Center for Numerical Analysis, The University of Texas at Austin, Austin, Texas 78712
10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: Project No. P-12301-M
11. CONTROLLING OFFICE NAME AND ADDRESS: U. S. Army Research Office, P. O. Box 12211, Research Triangle Park, No. Carolina 27709 (11) 31
12. REPORT DATE: Jan[illegible]78
13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office): (12) 5p.
15. SECURITY CLASS. (of this report)
15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

DDC RECEIVED MAR 20 1978 F

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)
18. SUPPLEMENTARY NOTES

The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) 14.5

This is the final report of the work performed under grant DAHC04 74 G 0198 for the period October 1, 1974, through November 30, 1977, at the Center for Numerical Analysis, The University of Texas at Austin. The report summarizes the research performed, lists the papers published and in progress, and lists the personnel who participated in the work.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

406262

AU No. DDC FILE COPY

Final Report

This is a report on the work done under grant DAHC04 74 G0198 during the period October 1, 1974, to November 30, 1977.

The research has been primarily concerned with the development and analysis of numerical methods for solving elliptic partial differential equations. One area of emphasis has been on the use of iterative methods to solve large systems of linear algebraic equations with sparse matrices. The iterative methods considered have included the symmetric SOR method (SSOR method) and various variants of the Jacobi method. The use of Chebyshev acceleration and conjugate gradient acceleration has been considered. The object was to develop algorithms where the required iteration parameters are determined automatically and where realistic stopping procedures are used.

Some of the results of the research are described in the papers and reports listed below. However, all of the results will be incorporated in a Monograph [P1] now in preparation by Dr. Young and by Dr. L. A. Hageman of the Westinghouse Bettis Atomic Power Laboratory. This will appear as a SIAM Monograph, the preparation of which was supported in part by the ARO. Work on the SSOR methods is described in [R6], [R7], [ITR-1], and [ITR-2]. Work on stopping and adaptive procedures is described in [R5], [R8], [ITR-1], and [ITR-2]. Some theoretical results on Chebyshev acceleration and conjugate gradient acceleration are described in [R1].

The research on iterative methods forms a basis for work on the ITPACK project, which involves the development of computer programs based on iterative methods for solving large sparse systems. Preliminary work in ITPACK is described in the report of Kincaid and Grimes [ITR-2]. It is intended that the programs of ITPACK will be used in connection with the programs of ELLPACK (which is concerned with numerical methods for solving elliptic partial differential equation).

Another aspect of the work was concerned with the use of finite element methods to solve time-dependent partial differential equations using finite element methods. Some of this work is described in the thesis of Dr. Linda Hayes [T1]. Other work is described in [R2] and [R3].

During the period of the grant Dr. Linda Hayes wrote her Ph.D. thesis (see [T1]). A Ph.D. thesis by Cecilia Chang Jea is in progress (see [T2]).

Publications

R1. L. A. Hageman, Franklin Luk, and David M. Young, "On the Acceleration of Iterative Methods," CNA-129, Center for Numerical Analysis, UT Austin, December 1977. (Prepublication copy enclosed.)

R2. Linda J. Hayes, "Generalization of Finite Element Alternating-direction Techniques to Non-rectangular Regions," pp. 385-393 in Applications of Computer Methods in Engineering, Vol. I (L. C. Wellford, Jr., ed.), Proceedings of the Symposium on Applications of Computer Methods in Engineering, School of Engineering, University of Southern California, August 23-26, 1977, Los Angeles, California. (Reprints enclosed.)

R3. Linda J. Hayes, Richard P. Kendall, and Mary F. Wheeler, "The Treatment of Sources and Sinks in Steady-state Reservoir Engineering Simulations," pp. 301-306 in Advances in Computer Methods for Partial Differential Equations, II (R. Vichnevetsky, ed.), IMACS(AICA), 1977. (Reprints enclosed.)

R4. David R. Kincaid and David M. Young, "The Development of a Computer Package for Solving a Class of Partial Differential Equations by Iterative Methods," Quarterly Journal of the AICA 3 (1975), 186-191. (Reprints sent November 1975.)

R5. David M. Young, "Iterative Solution of Linear and Nonlinear Systems Derived from Elliptic Partial Differential Equations," pp. 265-296 in Lecture Notes in Mathematics, "Computational Mechanics," (J. T. Oden, ed.), Springer-Verlag, New York, 1975. (Reprints sent November 1975.)

R6. David M. Young, "Iterative Methods for Solving Large Systems of Linear Equations," Acta Universitatis Carolinae Mathematica et Physics 15 (1974), 179-188. (Reprints sent November 1975.)

R7. David M. Young, "On the Accelerated SSOR Method for Solving Large Linear Systems," Advances in Mathematics 23 (1977), 215-271. (Reprints sent May 1977.)

R8. David M.Young, "Iterative Solution of Linear Systems Arising from Finite Element Techniques," pp. 439-464 in The Mathematics of Finite Elements and Applications II (J. R. Whiteman, ed.), Academic Press, 1976. (Reprints sent May 1977.)

Interim Technical Reports

ITR-1. Linda J. Hayes and David M. Young, "The Accelerated SSOR Method for Solving Large Linear Systems: Preliminary Report," ITR-CNA-123, Center for Numerical Analysis, UT Austin, May 1977. (Copies enclosed.)

ITR-2. David R. Kincaid and Roger G. Grimes, "ITPACK Report: Numerical Studies of Several Adaptive Iterative Algorithms," ITR-CNA-126, Center for Numerical Analysis, UT Austin, August 1977. (Copies enclosed.)

Work in Preparation

P1. L. A. Hageman and David M. Young, "Applied Iterative Methods," to appear as a SIAM Monograph.

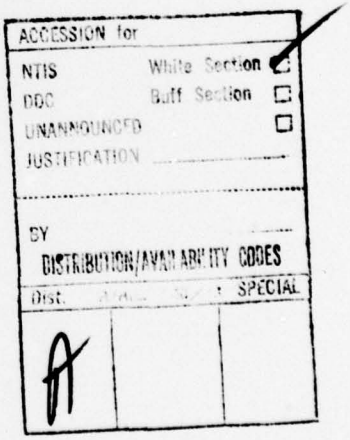
Graduate Theses

T1. Linda J. Hayes, "Generalization of Galerkin Alternating-direction Methods to Non-rectangular Regions Using Isoparametric Elements," Ph.D. dissertation, The University of Texas at Austin, 1977. (Copy enclosed.)

T2. Cecilia Chang Jea, "The Numerical Solution of Linear and Nonlinear Partial Differential Equations," Ph.D. dissertation in progress.

Personnel Who Participated in Grant Research*

Dr. David M. Young, Jr.	Director (and Professor of Mathematics and of Computer Sciences)
Dr. David R. Kincaid	Research Scientist (and Lecturer, Computer Sciences)
Dr. Nancy Nichols	Research Scientist (Visiting)
Dr. Linda J. Hayes**	Computer Programmer I
Stephen Wong	Computer Programmer I
Edward Schleicher	Computer Programmer I
James Sullivan	Computer Programmer I
Cecilia Chang Jea	Computer Programmer I
Roger Grimes	Computer Programmer I
Baker Kearfott	Computer Programmer I
William MacGregor	Computer Programmer I



*Not all were paid from grant funds.

**Received her Ph.D. degree in 1977 (see T1).